

Tuberothalamic Artery Infarction Following Coil Embolization of a Ruptured Posterior Communicating Artery Aneurysm Belonging to a Transitional Type Posterior Cerebral Artery

A Case Report

KYEONG DUK LEE, SOON CHAN KWON, SARAWANA MUNIANDY, EUN SUK PARK, HONG BO SIM, IN UK LYO

Department of Neurosurgery, Ulsan University Hospital, University of Ulsan College of Medicine; Ulsan, Korea

Key words: tuberothalamic artery, Allcock's test, fetal type posterior cerebral artery

Summary

There are many potential anatomical variations in the connection between the internal carotid artery and the posterior circulation through the posterior communicating artery (PCoA). We describe the endovascular treatment of an aneurysm arising near the origin of the PCoA belonging to a transitional type posterior cerebral artery. Coil embolization subsequently resulted in thrombo-occlusion of the adjacent PCoA causing thalamic infarction even though sufficient retrograde flow had been confirmed preoperatively by Allcock's test.

Introduction

A fetal type posterior communicating artery (PCoA) refers to an artery in which the dominant flow of the posterior cerebral artery (PCA) originates from the anterior circulation. Its incidence has been reported to vary from four to 29% of the population. Four to 12 branches (with an average of seven) with a diameter between 0.1 and 0.6 mm arise from the PCoA¹. The tuberothalamic artery commonly arises from the caudal part of the PCoA, which

is close to the PCA, or from the border between the caudal and middle third of the PCoA². The present report describes thrombo-occlusion of a thalomoperforating artery after coil embolization on rupture of a transitional type PCoA.

Case Report

A 67-year-old man was referred to our emergency room with an acute change in mental status. On examination he was noted to be stuporous. He had a history of head trauma 15 years ago, with minimal cognitive dysfunction. Computed tomography (CT) scan of the brain disclosed evidence of subarachnoid hemorrhage within the basal cisterns, with intraventricular extension and a moderate degree of hydrocephalus (Figure 1). Cerebral angiogram showed a large left PCoA area saccular aneurysm (Figure 2). A transitional type left PCoA, as described by van Raamt et al., was noted³. The flow to the left PCA was mainly supplied by the left PCoA. However adequate supply from the vertebro-basilar system was demonstrated by Allcock's test (Figure 3)⁴. Coiling of the aneurysm was done with the double catheter technique. The



Figure 1 A-C) Brain CT scans on admission show diffuse subarachnoid hemorrhage and intraventricular hemorrhage with hydrocephalus.

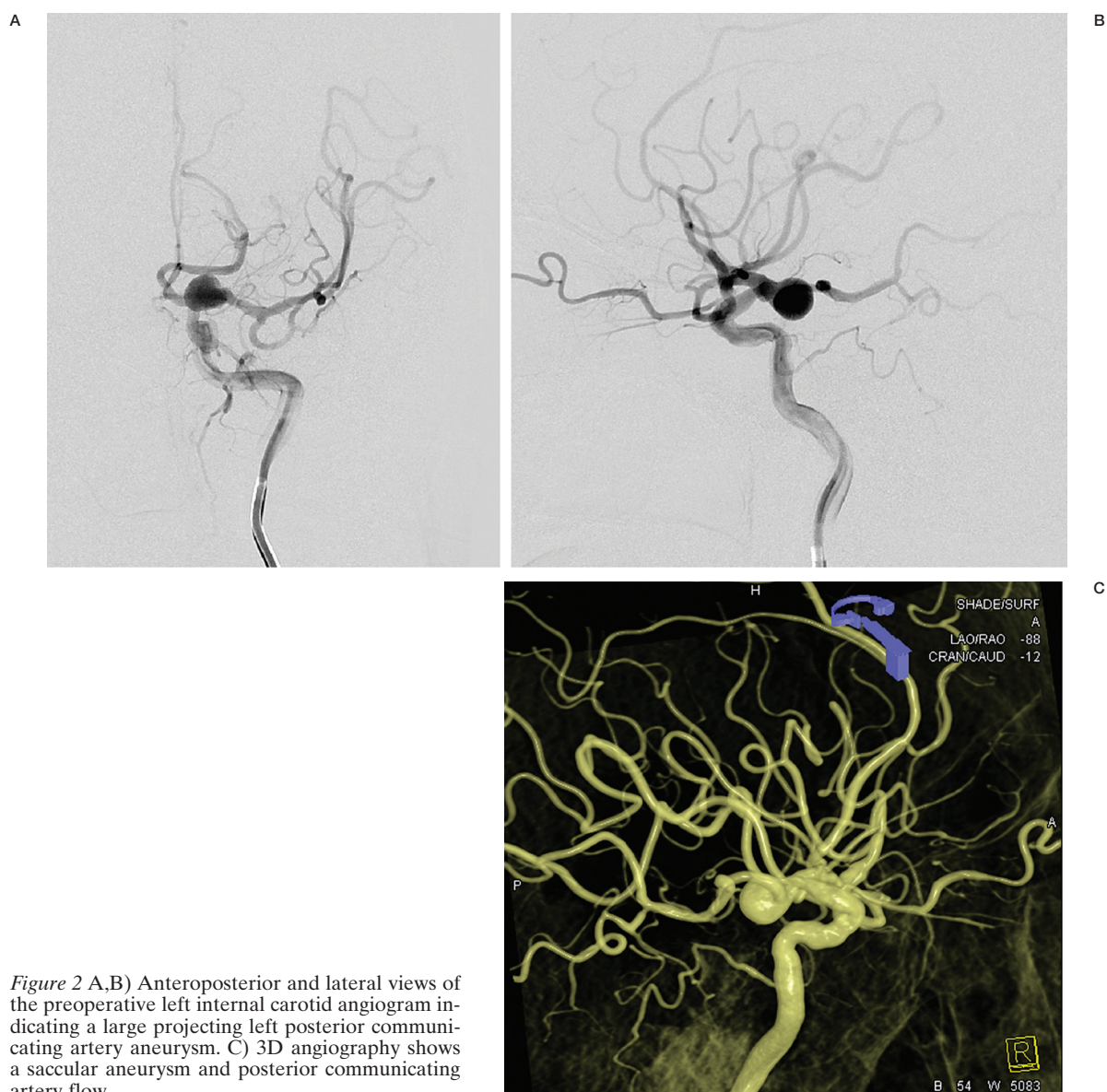
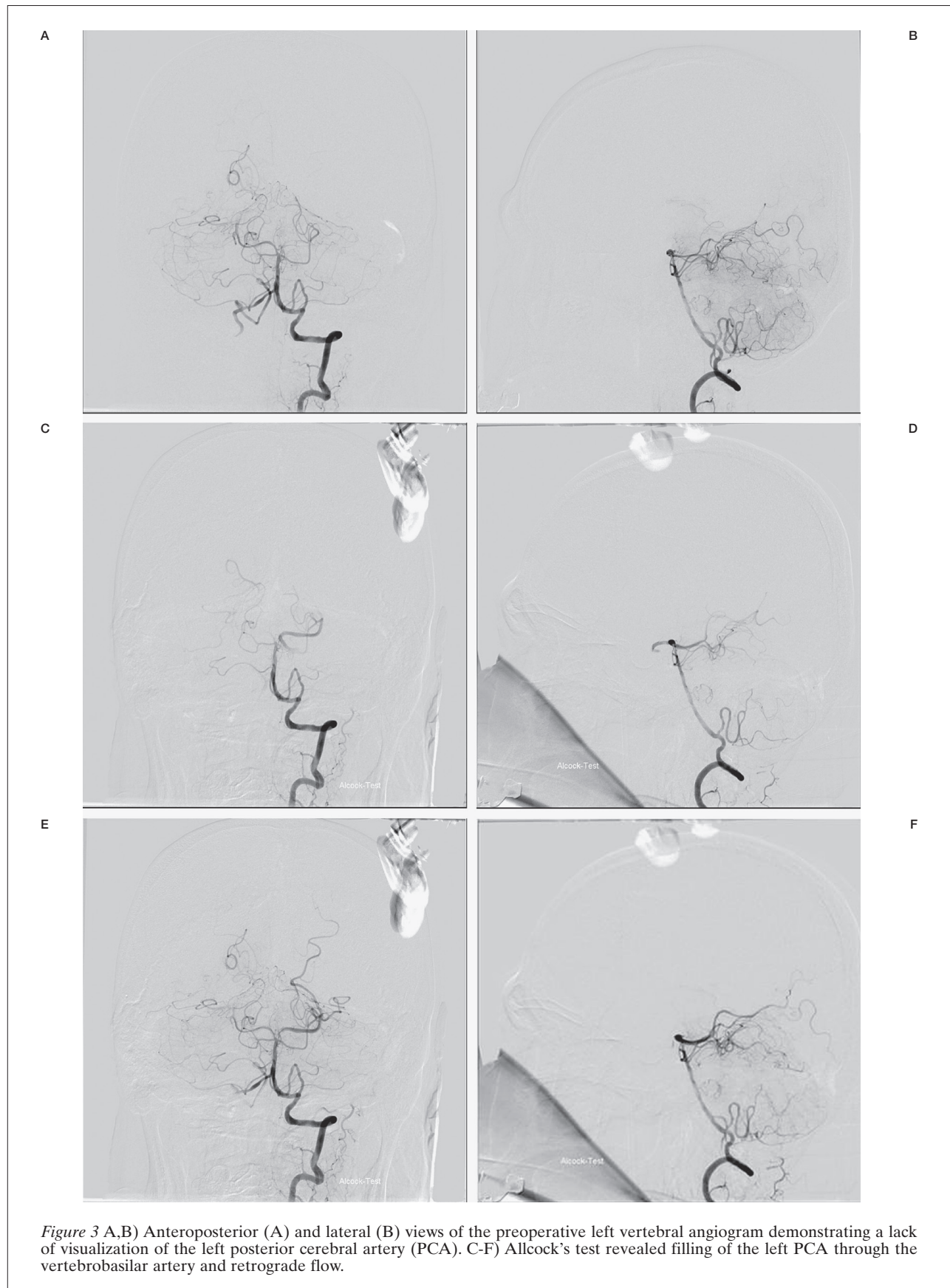


Figure 2 A,B) Anteroposterior and lateral views of the preoperative left internal carotid angiogram indicating a large projecting left posterior communicating artery aneurysm. C) 3D angiography shows a saccular aneurysm and posterior communicating artery flow.



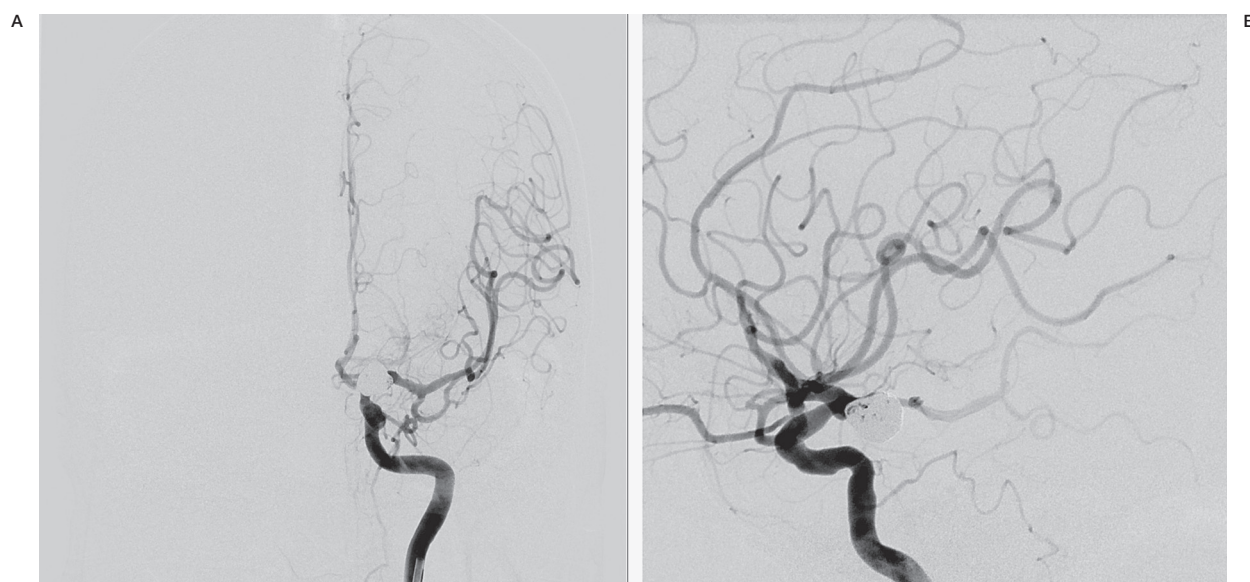


Figure 4 A,B) Anteroposterior (A) and lateral (B) views of the right internal carotid angiogram obtained immediately after coiling revealing complete elimination of the aneurysm along with the origin of the posterior communicating artery (PcoA), but flow of the left PcoA (B) was slightly decreased compared to the initial angiogram.

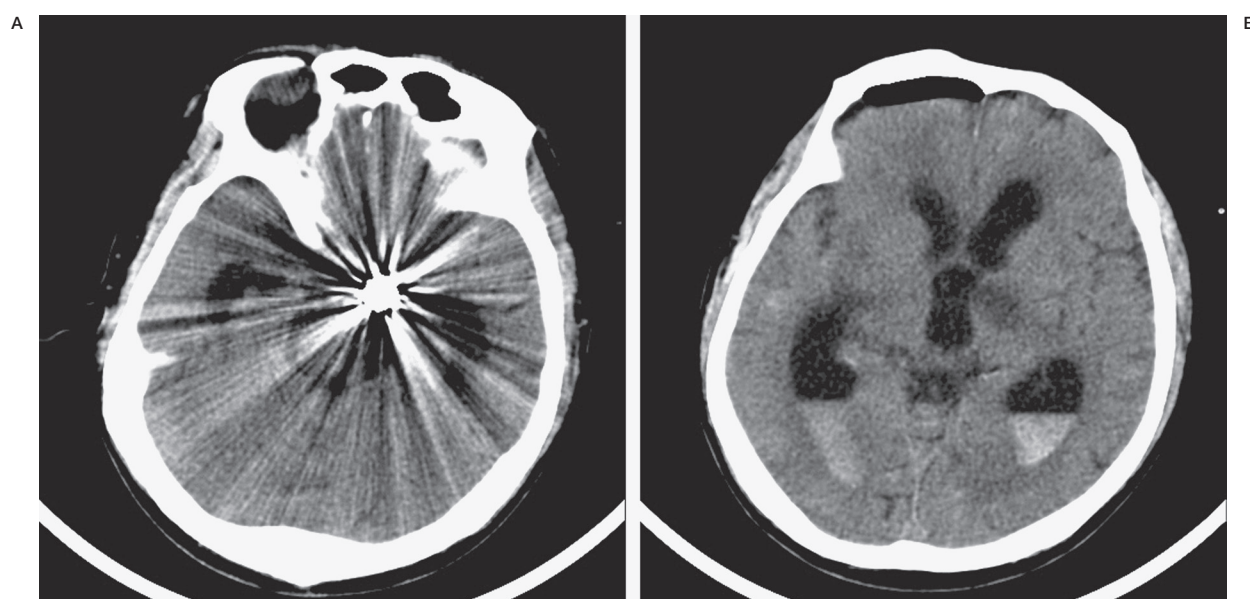


Figure 5 A,B) CT scan 4 days after coiling indicating tuberothalamic artery infarction.

PCoA was protected with a third microcatheter, Prowler 14 (Cordis Endovascular, Miami Lakes, FL, USA) placed within this vessel and continuously flushed with heparinized saline. All three micro-cannulations were done via a 7Fr guiding catheter positioned at the mid left internal carotid artery (ICA). The aneurysm was subsequently occluded with 16 detachable coils of various sizes. The post coiling angiogram showed

complete exclusion of the aneurysm (Figure 4), but there was a slight reduction in flow to the left PCoA. Examination of left vertebral artery showed preservation of flow to the left PCA from the vertebrobasilar system. The patient was noted to be stable immediately after coiling, but two days later right hemiparesis was noted. CT scans confirmed infarct of the left thalamus (Figure 5). Repeat angiogram (12 days later)

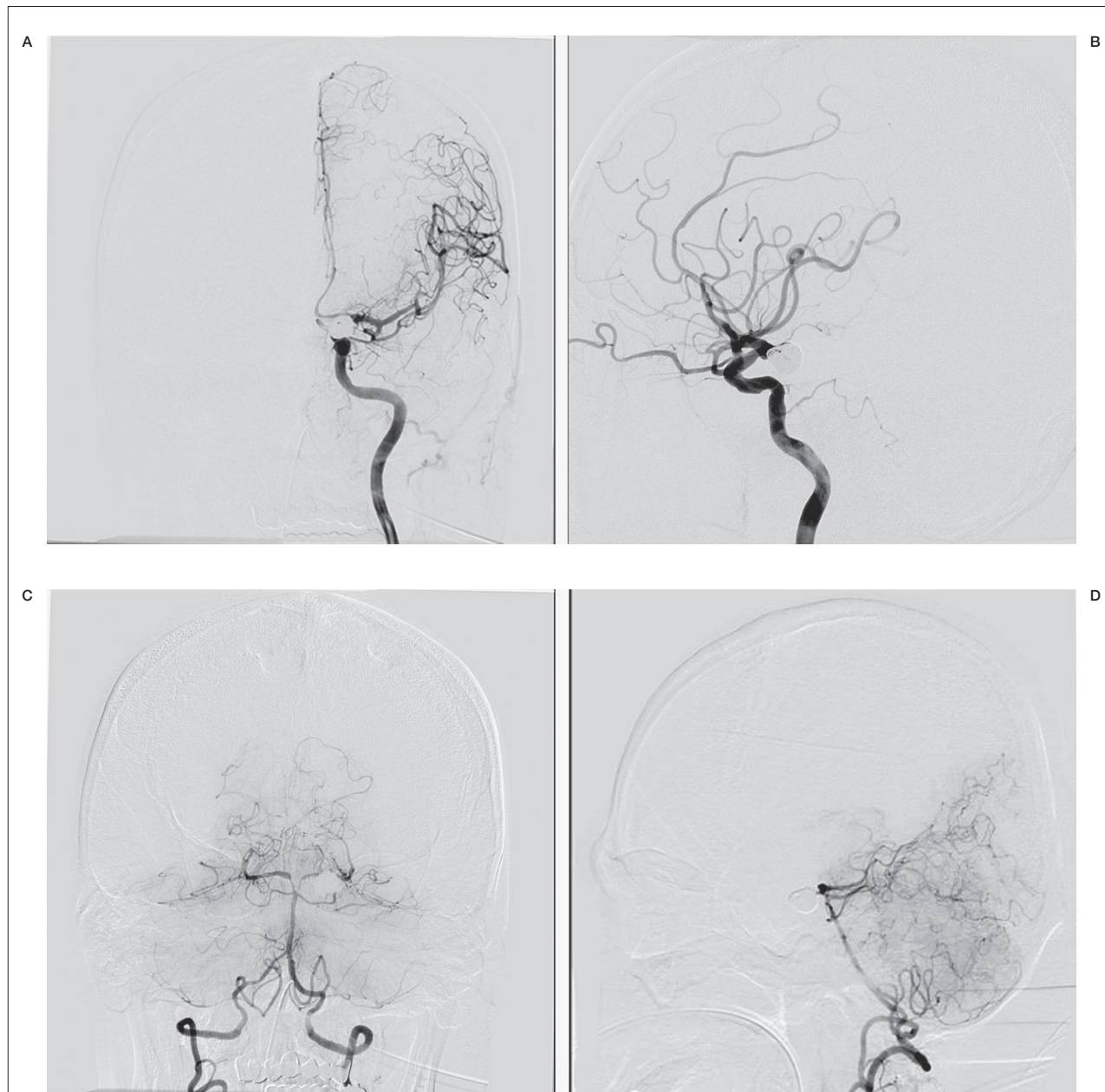


Figure 6 A,B) Follow-up cerebral angiogram (12 days after coiling), anteroposterior (A) and lateral (B) views of the left internal carotid angiogram show lack of visualization of the left posterior communicating artery compared to the initial angiogram. C,D) Anteroposterior (C) and lateral (D) views of the left vertebral angiogram show flow of the left posterior cerebral artery and minimal retrograde flow.

showed occlusion of the PCoA, but preservation of supply to the left posterior cerebral artery from the vertebrobasilar system (Figure 6).

Discussion

There are many potential anatomical variations in the connection between the ICA and

the posterior circulation through the PCoA. In undertaking endovascular treatment of aneurysms in the PCoA area, specific considerations need to be given to the anatomy of this region. More often than not, these aneurysms occur in the presence of a fetal type PCA (FTP)⁵. One study using magnetic resonance imaging found 47% percent of ICA aneurysms occurred in the presence of some form of FTP⁶. Others have

shown that PCoA area aneurysms may account for 25% of all ruptured aneurysms⁷.

The term fetal type posterior circle of Willis PCA refers to a large PCoA providing the dominant supply to the PCA territory. At the eighth gestational week, the PCA exists as continuation of the PCoA. Later on there is relative regression of the PCoA and the PCA derives its supply mainly from the basilar system. In some cases, this progression may vary, with some adults maintaining the fetal pattern of the posterior circle of Willis⁸. In such cases, the main consideration is preservation of the FTP, as the supply to the PCA territory would be dependent on this vessel. However, there can be a variable contribution from the vertebrobasilar system via the P1 segment. For more accurate characterization of this variation, we used the description proposed by van Raamt et al. in their 2006 paper.

Our patient presented a transitional type FTP in which the PCoA was the same size as the P1 segment. Thus, because it can be assumed that the FTP was occluded during coiling of the aneurysm, the supply to the PCA should have been preserved via the supply from the vertebrobasilar system.

An equally important consideration is the perforating vessels (PV) from the PCoA. These are end arteries that supply areas of the brainstem and deep areas of the brain⁹. The most important of these branches is the tuberothalamic artery arising from the ICA side of the PCoA¹⁰, which has also been referred to as the thalamotuberal artery, premamillary artery, polar artery, and anterior thalamoperforating artery¹¹. The origin of this and another seven PV are not easily identified by angiography. Thus

the PCoA needs to be preserved even if there is adequate supply to the posterior circulation via the vertebrobasilar system.

A retrospective review identified 14 patients with ruptured PCoA aneurysms who underwent embolization of the aneurysm in combination with PCoA sacrifice. Postoperative diffusion-weighted imaging indicated seven cases with infarctions and seven without, even though preoperative Allcock's test had demonstrated a retrograde filling of the PCoA through the P1 segment in all 14 cases¹¹.

Unfortunately, our patient suffered thrombo-occlusion of the PCoA adjacent to the aneurysm despite precautions taken during coiling. We believe the loss of PCoA supply to the PV was responsible for the fatal infarction he suffered even though retrograde flow was confirmed by Allcock's test.

We think that clipping is better than coiling for a Pcom aneurysm with a transition type Pcom artery from the viewpoint of preserving the flow to the perforators originating from the Pcom and the parent artery, the Pcom itself.

Conclusion

In endovascular treatment of a PCoA area aneurysm it is important to preserve the supply to the adjacent PCoA even if there is adequate supply to the posterior circulation via the vertebrobasilar system because the tuberothalamic artery originates from the ICA side of the PCoA. PCoA flow from the ICA should be preserved, especially in the case of FTP, even when sufficient retrograde flow is confirmed by Allcock's test.

References

- 1 Saeki N, Rhoton AL, Jr. Microsurgical anatomy of the upper basilar artery and the posterior circle of Willis. *J Neurosurg.* 1977; 46: 563-578.
- 2 Bogousslavsky J, Regli F, Assal G. The syndrome of unilateral tuberothalamic artery territory infarction. *Stroke.* 1986; 17: 434-441.
- 3 van Raamt AF, Mali WP, van Laar PJ, et al. The fetal variant of the circle of Willis and its influence on the cerebral collateral circulation. *Cerebrovasc Dis.* 2006; 22: 217-224.
- 4 Drake CG. Giant intracranial aneurysms: experience with surgical treatment in 174 patients. *Clin Neurosurg.* 1979; 26: 12-95.
- 5 Bisaria KK. Anomalies of the posterior communicating artery and their potential clinical significance. *J Neurosurg.* 1984; 60: 572-576.
- 6 Horikoshi T, Akiyama I, Yamagata Z, et al. Magnetic resonance angiographic evidence of sex-linked variations in the circle of willis and the occurrence of cerebral aneurysms. *J Neurosurg.* 2002; 96: 697-703.
- 7 de Aguiar PHP, Zicarelli CAM, Aires R, et al. Posterior Communicating Artery Aneurysms: Technical Pitfalls. *Neurosurg Q.* 2010; 20: 74-81.
- 8 Caldemeyer KS, Carrico JB, Mathews VP. The radiology and embryology of anomalous arteries of the head and neck. *Am J Roentgenol.* 1998;170: 197-203.
- 9 Beumer D, Delwel EJ, Kleinrensink GJ, et al. The perforator-free zone of the posterior communicating artery and its relevance in approaches to the interpeduncular cistern, especially the transcavernous approach: an anatomic study. *Neurosurgery.* 2007; 61: 187-191; discussion 191-182.
- 10 Gabrovsky N. Microanatomical bases for intraoperative division of the posterior communicating artery. *Acta Neurochir (Wien).* 2002; 144: 1205-1211.
- 11 Endo H, Sato K, Kondo R, et al. Tuberothalamic artery infarctions following coil embolization of ruptured posterior communicating artery aneurysms with posterior communicating artery sacrifice. *Am J Neuroradiol.* 2012; 33: 500-506.

Soon Chan Kwon MD, Ph.D
Department of Neurosurgery
Ulsan University Hospital, 290-3
Jeonha-Dong, Dong Gu, Ulsan 682-714, Korea
Tel.: +82-52-250-7139
Fax: +82-52-250-7138
E-mail: nskwon.sc@gmail.com